

IV. EMERGING TECHNOLOGY

A. NASA Autonomous Flight Safety System (AFSS)

There were several significant developments on the NASA AFSS during 2012. The following is a brief description capturing the highlights.

1. Independent Verification and Validation (IV&V)

The NASA IV&V Center produced a preliminary hazard and fault tree analysis for the NASA AFSS design that flew on the third rocket test in 2009. A closely-related effort was a draft AFSS software requirements document that will be provided to all interested users.

2. Reusable Flyback Booster

NASA worked with the AFRL at Wright Patterson Air Force Base and Northrop Grumman Aerospace to support AFRL's reusable flyback booster work. Preliminary AFSS rule sets were developed for flyback boosters which were incorporated into detailed simulations running the NASA AFSS software. Northrop Grumman, AFRL, and their contractors in return supported NASA's continued AFSS requirements and ground support equipment development.

As a result of this flyback booster collaboration, Northrop Grumman asked NASA to work with them on the DARPA ALASA project. Northrop Grumman will use the NASA AFSS software to develop a rapid mission planning capability called Safety and Mission Planning for Air Launch (SAMPAL), and KSC will support Northrop Grumman and other ALASA contractors.

3. Code Standardization

Wallops Flight Facility supported code standardization, implementation of its AFSS software, and hardware-in-the-loop testing of the ATK-developed AFSS hardware for Operationally Response Space.

B. Joint Advanced Range Safety System (JARSS)

JARSS is a state-of-the-art, government-owned tool for range safety mission planning, risk analysis, and risk management. It has evolved over several years from its beginning as a collaborative effort between DFRC and the Air Force Flight Test Center at Edwards Air Force Base. The objective of JARSS is to provide range safety support for the development, testing, and operation of UAS, ELV, and RLV. In the past year, WFF adopted JARSS to provide real-time displays in support of operations. KSC has been using JARSS to explore the possibility of applying the tool to new vehicles that may come to KSC after fly-out of the Space Shuttle. Other milestones for JARSS are described below:

1. Population Data Ingest Improvement

The evolution of JARSS continued this year with NRS-provided funding to automate the ingest of user-specified population data. Previous versions of JARSS allowed input of unique population sites, but the process was tedious since each site had to be entered separately by the user. The old process was time consuming and vulnerable to input errors, especially when tens, even hundreds, of sites were needed. NRS leveraged the existing JARSS capability to

parse Excel spreadsheet data and customized a JARSS utility to read a population data file in the format used by KSC. This new capability allows the user to input an entire spreadsheet of unique population sites into JARSS via a graphical user interface (GUI). The new functionality greatly improves the efficiency of mission-specific population handling and eliminates a potential error source.

2. OTV-2 Support

For the second time, JARSS Mission Planning and Real Time tools successfully supported landing operations of the X-37B reentry vehicle. After 15 months in orbit, the spacecraft touched down at California's Vandenberg Air Force Base on June 16, 2012. The vehicle is shown shortly after touchdown in Figure 11. JARSS Mission Planning tools made it possible for analysts to meet the critical time lines for this mission. JARSS Real Time processed vehicle telemetry data and provided both critical flight safety information and high fidelity mission awareness information. It is anticipated that the next X-37B mission may target landing at KSC's Shuttle Landing Facility (SLF).



FIGURE 11: OTV-2 POST LANDING AT VAFB

3. AFSS Configuration

JARSS was modified to provide a user interface for flight analysts to make the configuration files containing the safety rules AFSS needs for specific missions. This is an important step in providing ground support equipment and tools to help flight analysts become familiar with AFSS for planning and eventual acceptance and operational use. A sample is shown in Figure 12, below.

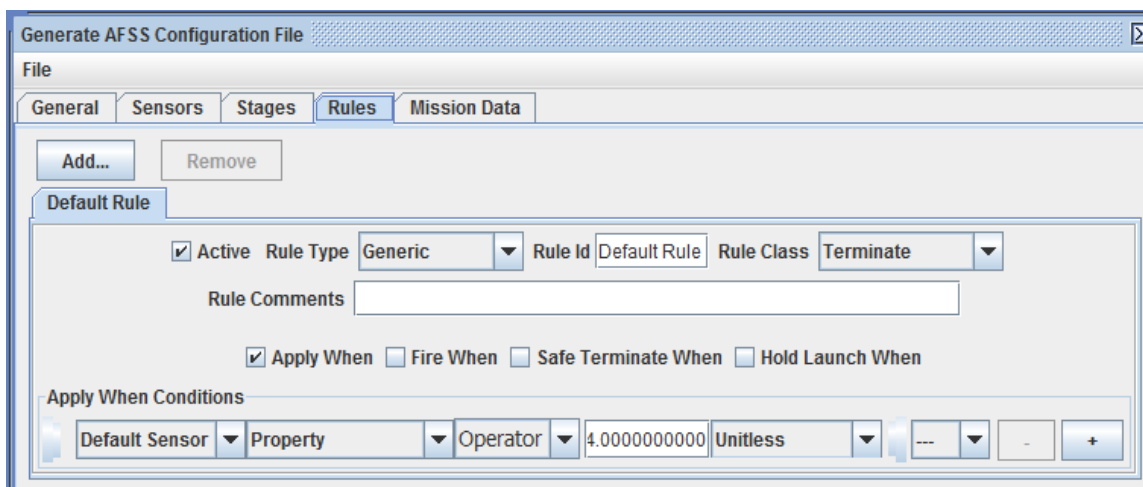


FIGURE 12: JARSS USER INTERFACE FOR FLIGHT ANALYSIS

4. Forward Work

A new project will start next year to build an integrated flight analyst software suite within JARSS using the NASA AFSS code and the configuration file builder developed this year. This project will allow flight analysts to make the AFSS mission rules, run these rules for a given mission through the AFSS software, visualize the trajectory, and perform post-test analysis on a single PC.